AIR PURIFICATION

By HENRY WEISZ, E.E. IV

THE problem of industrial haze, dirt, dust, welding fumes and soot has long confronted industry with economic losses in air conditioned and forced ventilated buildings. These losses amount to a toll or tax which will never be reduced until this cause is eliminated. Smoke or soot the worst offender, blackens and damages wallpaper, paint, decoration, fabrics, books, records and a mass of valuable property.

Merchants, bankers, hotel and restaurant proprietors, office building managements, those in control of hospitals, textile mills, steel mills and other industrial plants, laboratories, telephone exchanges, public buildings, etc. are all conscious of the havoc wrought by dirt.

In these establishments the increasingly frequent cleaning and dusting bills, the oft-repeated redecorating costs, and the widespread ruination of merchandise and equipment by dust and dirt, entirely apart from the health angle, present a staggering total.

This condition has been accepted as inevitable up to this time because no practical method has ever been devised to really and truly clean the air of the very fine particles which are present by the billions and are pumped into the ventilated spaces by fans.

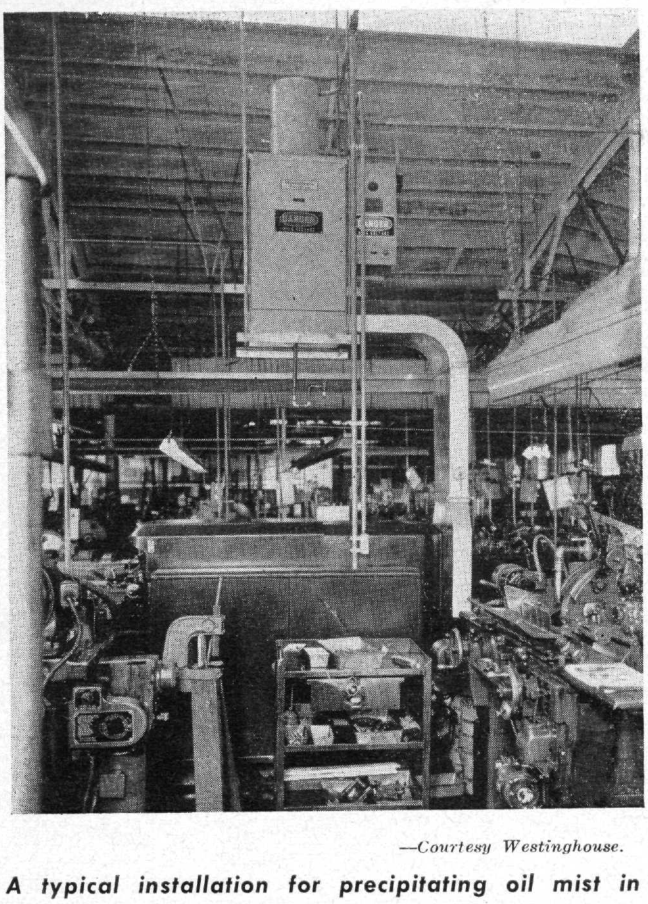
For instance, who has not observed the dirty streaks on the walls and ceiling around a ventilating grill, the dust and dirt in spaces served by a forced ventilating or air conditioning system?

Under normal conditions, each cubic foot of city air may contain from 1,000,000 to 4,000,000 foreign particles, many of which may be pollen or bacteria.

These particles are measured by the minute metric unit known as the "micron." A micron is equal to one thousandth of a millimeter, or 1/25000 of an inch.

Particles larger than 1 micron usually tend to settle from the air unless it is in motion. Since we are interested in air in motion, we are concerned with the particles it carries, ranging from heavy industrial dust of 8000 microns down to smoke particles as small as 1/10 micron.

Tobacco smoke particles measure 1/10 of a micron. Other smoke particles such as those that make up the black smoke from coal-burning furnaces in homes, boiler stacks, and the like vary in size but on the average are only 0.3 microns in diameter. Silica dusts and common bacteria are about 1 micron in size. Other particles range in diameter from 10 microns to 50 microns; a 10 micron particle is about the smallest that can be seen with the naked eye.



—*Courtesy Westinghouse.*

A typical installation for precipitating oil mist in machine shops.

Studies made by the Mellon Institute and U. S. Department of Health reveal the fact that above our cities floats a cloud of dust and smoke whose density is anywhere from 1 million to 4 million particles per cubic foot, as compared with the country air content of about 200,000. Analysis of typical samples of these dusts show that: 45-47 percent of these particles are smoke or soot from 1/10 to 3/10 micron in size; 40-43 percent are silicious matter from 3/10 to 1 micron in size; the remaining 15 or 20 percent are coal dust, fibrous matter and other miscellaneous particles varying in size from 1 micron up.

It is seen therefore that by far the largest percentage, 80 to 90 percent, of all particles in the air are less than 1 micron in size. Unfortunately they are the most difficult to catch, but cause the most damage.

Modern mechanical air filters are grouped as throwaways, permanent (cleanable), replacement (fabric) and continuous oil (automatic). Yet it must be remembered that air filtering is far removed from air cleaning.

All these filters are built on the principle of viscous surface impingement, screening, or a combination of the two.

The greatest disadvantage of these filters is their inability to stop the very small particles which constitute 80 to 90 per cent of the total particles in normal atmospheric air.

The maintenance of these filters also presents a particularly dirty job of cleaning or replacing the filtering medium.

A fallacy has been allowed to persist for many years, and that is the accepted method of testing air cleaning efficiency—the weight test. In this test, a "standard" artificial dust is used and weighed both before and after it is passed through the filter. There is no such thing as a "standard dust" in the air because we all know that atmospheric air pollution varies greatly from day to day, season to season and locality to locality.

Since the function of any air cleaner is to remove dirt existing in the air— a floating dirt that blackens walls, drapes, merchandise and other materials—a new test method has been developed by the National Bureau of Standards, known as the "Blackness Test". It is the relation between the time required to obtain a spot of equal blackness on the clean side to that on the air side when cleaning normal atmospheric air.

That is, if it takes 10 minutes to obtain a spot of equal blackness of the clean air side and one minute on the dirty air side, the cleaner is said to be 90% efficient. That is, 9/10 of all the dirt in the air which causes the blackness is removed.

In a two stage precipitator the two functions of charging and precipitating are separated. The dust particle first passes through a high local electrostatic field produced by impressing a high voltage (12,000-13,000 volt d-c) on a fine wire. Here the particles become charged or "ionized." The particle then passes into a non-discharging uniform electrostatic field, created by a system of parallel plates, alternate plates being grounded and the remaining plates being connected to a source of high d-c potential (6000volts d-c). There the particle is pulled to the electrode of opposite polarity.

Particularly successful has been an adaption which catches oil mist at high-speed grinders. The fast-spinning tool heats and thrashes the cooling oil into a cloud that fills the atmosphere. In some plants it has created a fire hazard. It condenses on walls and pipes, causes premature electrical insulation failures and makes working environment unpleasant. Removal of the oil mist at its source not only eliminates these objections but also recovers the lubricant for re-use. Due to this saving, some plants are now able to use a better, more expensive cutting oil to obtain greater production. Precipitators for oil mist removal, have now proved themselves highly successful in dozens of plants.

War has placed new emphasis on food processing. It has developed the dehydrated foods industry to full stature and electrostatic air cleaning is playing its part. Powdered milk plants use precipitators to keep dust out of the large volume of warm air required for dehydration. Thus, the plant can be built in the city close to distribution centers and labor supply. Formerly, they were located less-conveniently in the country where clean air was plentiful.

Blast-furnace gases are used as fuel for engines and furnaces. Naturally, dust in the gas is injurious—it is ruinous to engine valves and cylinder walls and gums up furnace nozzles. A trial precipitator on one steel company's blast-furnace gas supply gives hopeful indication that it can cope with this severe dust problem.

All applications for electric air cleaning for the ventilation of machine tools to date have been made on machines already in use. This involves the use of sheet metal hoods and ducts and a separate housing for the air cleaning equipment.

In many types of machine tools it would be possible to design the machines to incorporate the ventilating system and electric air cleaner within the housing of the machine. This will require close cooperation between the manufacturers of machine tools and the manufacturers of electric air cleaners.